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# The Business Of Electric Vehicles

September 25th, 2019 by [Guest Contributor](#)

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Originally published on [Medium](#).

By [Todd Medema](#)

Read Part 1, [The Geopolitical Challenges Of Electric Vehicles](#). Part 3 coming in October.

In Q2 2019, Americans purchased **4,430,000 passenger cars**.

2.1% of those (**92,599**) were electric vehicles — up from **0.9%** in 2016.

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Electric Vehicle (EV) sales threaten \$4.3 trillion in annual revenue (\$3T from **gas automakers**, \$1.3T from **gasoline**):

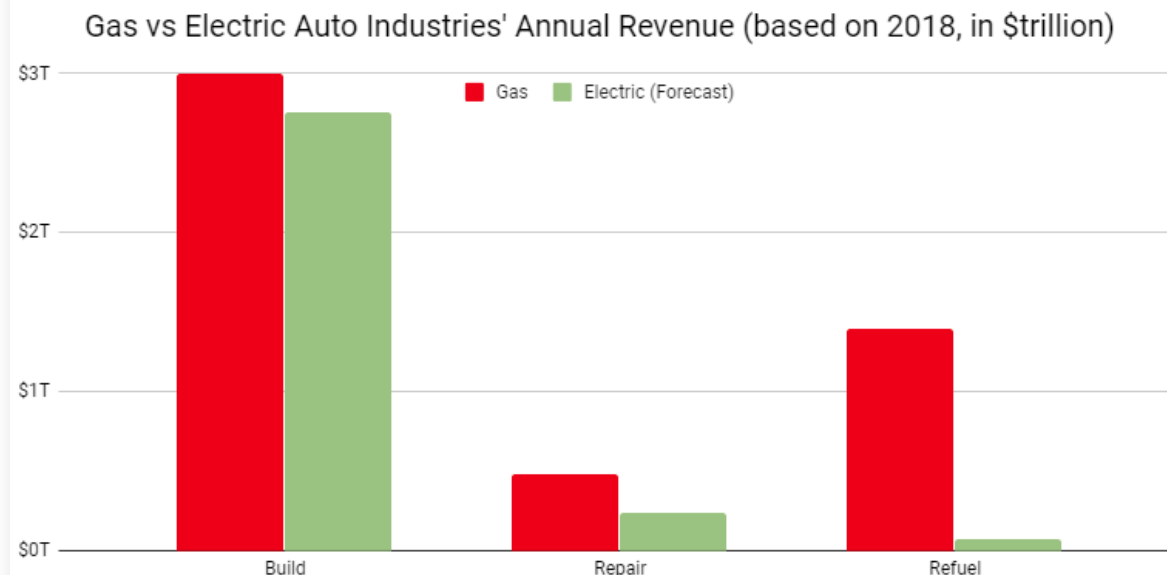


Chart: Todd Medema, analysis here

To understand what a shift to 100% electric might look like — and whether it's even possible — we'll need to understand the three core auto industries: **making**, **dealing** (selling & repairing), and **fueling**.

Finally, we'll explore two hot topics that influence these industries: **Consumer Demand** and **Executive Compensation**.

## 1. The Making of Vehicles

In 2008, the US Government spent **\$80 billion** of taxpayer money to bail out America's "Big 3," with promises that they would become more efficient.

Although they eventually returned all but \$10 billion to taxpayers, they've failed to become more efficient: **Most Americans today** choose to buy cars from non-American companies, presumably because they're better cars.



Where Are They Now? "HUGE" Tesla Model 3 Issues That Are No Longer Issues



The Netherlands Surpasses Wildest Predictions For Tesla Model 3 Sales



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Tesla 3rd Quarter Sales Grew 1664% In 6 Years, 271% In 2 Years



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At the same time, the global auto industry is **shrinking** as people **hold on to cars longer** and even **opt out of cars entirely**. (Ford alone is cutting **7,000** jobs).

Looking forward, innovation threatens their core business: gas vehicles have a **20%** profit margin, but EVs are forecasted to be closer to **5%** at scale.

## Why would they change?

- Many cities and countries are banning the sale of new combustion engines.
- But, such a large change is expensive and too far out for CEOs to care (more on that in the Executive Compensation section).
- With only 2% of car sales as EVs, there's a chicken-and-egg problem: why would any manufacturer invest in making them at scale if they aren't already selling at scale? But how can they make them affordable enough to sell at scale if they aren't made at scale?
- Thankfully, a few manufacturers have already pledged to grow EV sales: Daimler recently announced that it is stopping investing in new gas cars, and GM intends to produce 1 million EVs a year by 2026 (although, since few companies are *actually* building EVs at scale today, these CEOs *could* be bluffing to inflate the value of their stock before they retire)

## Could they change?

Technology-wise, car companies are clearly capable of producing good EVs. For example, the 2019 Nissan Leaf has about the same range as a Tesla Model 3 (**226 miles**), while Jaguar's new I-Pace SUV won **Car of the Year** and the Hyundai Kona earned **Best Utility Vehicle**.

Even if they can make good EVs, switching to a new technology is never easy. What would it take for US manufacturers to build EV replacements for the **272 million** cars in the US (**~17 million cars built per year**)?

### Sourcing raw materials

The first challenge is acquiring the raw materials to build that many cars.



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For our calculations, let's assume that all EVs are full-range models like the Model S (370 miles of range, 100 kWh). In reality, some will be smaller (smart cars, hybrids, urban commuters), and others will be larger (SUVs, trucks), so we'll use this as a middle estimate.

Here's the analysis for the primary resources used in EV batteries:

Primary resources in EV batteries					
1 mt = 1,000 kg	<b>Cobalt</b>	<b>Copper</b>	<b>Graphite</b>	<b>Lithium</b>	<b>Nickel</b>
2018 global production (mt)	140,000	21,000,000	840,000	85,000	2,100,000
Per EV (mt)	0.008	0.08	0.05	0.05	0.06
Needed for 17 million EVs/yr (mt)	136,000	1,360,000	918,000	850,000	1,088,000
Reserves (mt)	132,000,000	5,000,000,000	800,000,000	56,000,000	117,000,000
Enough to replace 272m cars?	YES	YES	YES	YES	YES
Years of reserves	859	237	859	329	53

medium.com/@toddmedema

Analysis (data from usgs.gov)

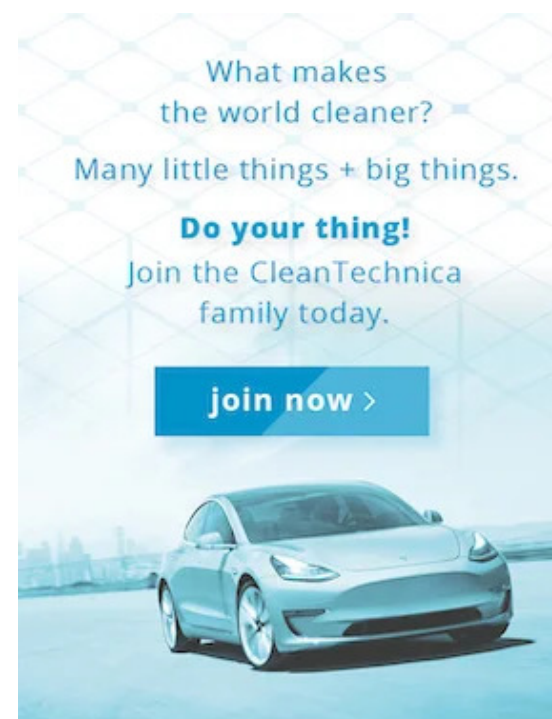
Overall, there are plenty of resources available, with two main challenges:

- Lithium mining will need to increase 10x to meet demand — but mining companies are already aggressively expanding capacity.
- Known nickel reserves only last 53 years in this scenario. With 68% of nickel already recycled, we can extend this deadline by a decade or two by increasing recycling rates, but we'll need to find an alternative by the 22nd century — either by using other materials or mining asteroids (there are *single asteroids* estimated to contain over 30 million tons of nickel, which equals 15 years of global production).

### Sidebar: What about recycling?

In the long term, EV batteries are highly recyclable and require minimal new mining (99.3% of lead acid batteries are recycled). But, since modern EV batteries are expected to last at least 8 years / 100,000 miles and EV batteries have a productive second life as home-scale battery backups, most won't be recycled for 15–30 years after their initial production.

Once they start getting recycled, we'll achieve a strongly circular economy, with most of the resources used in EVs being infinitely recyclable. Plus, since recycling has a smaller



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energy footprint than mining (recycled aluminum uses 95% less energy than new mining), EVs produced from recycled resources will have an even smaller environmental impact.

Until then, we'll have to scale up mining to meet demand.

### Retooling factories: Robots and humans

- Companies are capable of rapidly changing capabilities when they want to. Ford recently converted their largest factory in just 8 weeks. With 65 factories worldwide, Ford is capable of converting their production within 5 years (assuming one at a time, and only half need to be converted given similarities between platforms — in reality, it could be much faster as they gain expertise and do multiple at a time)
- As far back as the 80s, factories replaced 90% of their jobs with robots. In new Tesla factories, there are almost no humans. Any company retooling for EVs will need to be heavily automated to be competitive.
- Unions are no longer an excuse, either. Decades of concessions and corruption scandals have eroded their power, and membership has declined from 35% in 1954 to just 11% today.
- However, legacy auto makers are trapped into using manual labor with nearly \$4.5 billion in tax subsidies for creating 86,000 jobs (even though job creation subsidies don't work). They're required to maintain this level through 2032 or face large fines.
- They're also trapped into supply and assembly contracts: Most auto manufacturers' contracts last the life of a model (4 to 7 years) and have minimum demand clauses, which means any new gas models in 2020 could have to be paid for all the way into 2027.
- Thus, the biggest risk here isn't companies' *ability* to change, but rather their long-term agreements with governments and contractors.

## What would manufacturers look like in an EV future?

- Lower volume: EVs are expected to have longer service lives than gas cars, so future consumers won't need to purchase new cars as often.
- Streamlined options: Lower volume means manufacturers with fewer models will have a cost advantage. Already see this happening: Toyota "ePalette" uses the same battery and motor bed for many models, and the Tesla Model Y shares 76% of its parts with the Model 3.

- New sources of profit: Because EV margins are lower, companies will need to become more efficient or find new profit models. For example, most of Apple's profits come not from the iPhone, but from the App Store (which has a 63% profit margin, vs 34% for the iPhone). We might start to see Transportation as a Service, bundling car ownership with ride- or car-sharing as a monthly subscription. Or, manufacturers might shift away from consumers to focus ride-sharing or delivery fleets, since businesses will pay a premium for increased efficiency and durability.
- Vertical re-integration: Cars are already becoming more like cellphones, where most manufacturers heavily outsource and use the same commodity components, differentiating on style and software. The few companies big enough to custom build everything (i.e. Apple) will have tremendously differentiated products with higher profits. See: Apple ships only 19% of phones yet makes 87% of the profit. Also see: 70% of EV batteries are made by just 5 companies.

In summary: Auto manufacturers are capable of rapidly changing their production capabilities and there are plenty of raw materials. Yet, their CEOs delay because they aren't incentivised to innovate at the decade scale.

## 2. Dealerships: Selling and Repairing Vehicles

Dealerships currently make 50% of their profit from service and parts (auto repair is worth \$69B per year in the US, \$480B globally), 25% from used vehicles and 25% from new vehicles (mostly from financing + volume, not actual profit from the vehicle).

### Why would they change?

- Dealerships sell what manufacturers advertise and build.
- But, because EVs require less maintenance, they threaten dealerships' profit center. One Canadian study found that EV owners spent half of what gas car owners do on maintenance.

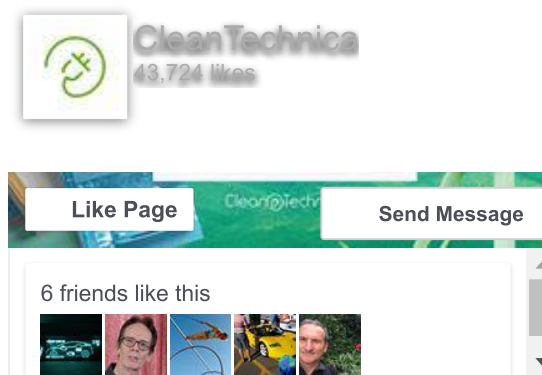
### Could they change?

- Repairs: Many automotive mechanics skills are transferable (replacing wheels, windshields, etc), but drivetrain skills will have to be relearned via something like an associates degree program or apprenticeship. As EV adoption increases, expect to see retraining programs offering classes for those who already have experience in gas car repair.

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Our Electric Car Driver Report



- Sales: Car companies currently spend less than 1% of their advertising budgets on EVs. Dealerships would have a much easier time selling cars that are actually advertised (more on this in "Consumer Demand").

## What would dealerships look like in an EV future?

- Showrooms: Since the total volume of car sales will be lower, dealerships should stock fewer cars in inventory — enabling them to be smaller and located in more desirable areas. More dealerships might drop inventory entirely and switch to a showroom-only model subsidized by the manufacturer as a marketing expense.
- Online sales: Following the rapid growth of eCommerce, car sales are moving online. Dealerships have already been waging a misinformation campaign for over 20 years to delay their obsolescence.
- Auto shop consolidation: As already noted, EVs need less maintenance. Additionally, many new cars (both gas and electrics) are capable of automatically diagnosing issues without visiting a mechanic. With fewer repairs needed, some shops will go out of business and others may switch to the Tesla-style drive-to-customer to reduce fixed location costs or merge with similar services (such as electronics repair shops).

## 3. Refueling (by gasoline or electrons)

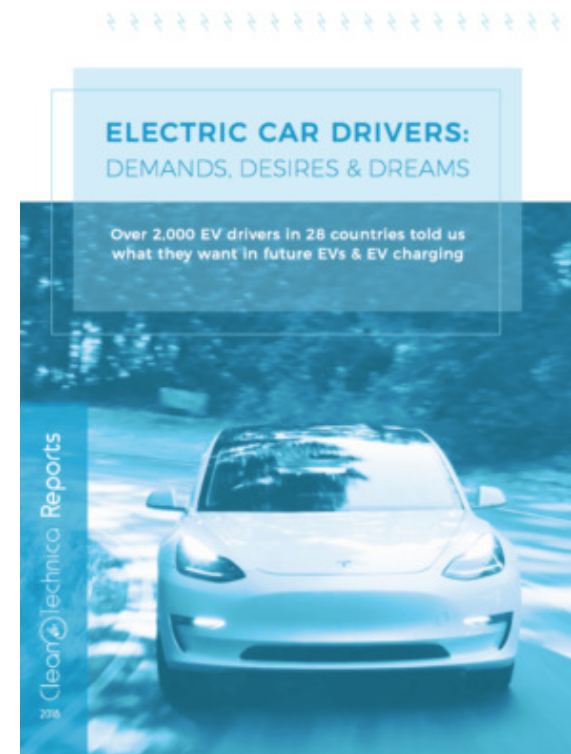
Think manufacturers and dealers have a reason to be scared? Gasoline for transportation earns corporations \$1.4 trillion per year (\$2 trillion for all of oil and gas, 71% of which is used in transportation). While gas manufacturers can pivot to EVs, oil drills are dead in the water in an electric future.

## Why would they change?

- For the same initial investment, wind + solar + batteries provide 6x as much energy as oil. If oil companies don't pivot, they'll be priced out of the energy market, just like how coal already is.
- Gas stations only earn 3 cents per gallon — most of their profit comes from concessions, and folks charging EVs will have more time to shop. But, 80% of EV charging happens at home.
- Prone to explosions and pollution, neighborhood groups have been fighting against gas stations for years. In fact, the total number of gas stations has declined by more than

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The EV Safety Advantage



50,000 in the last decade.

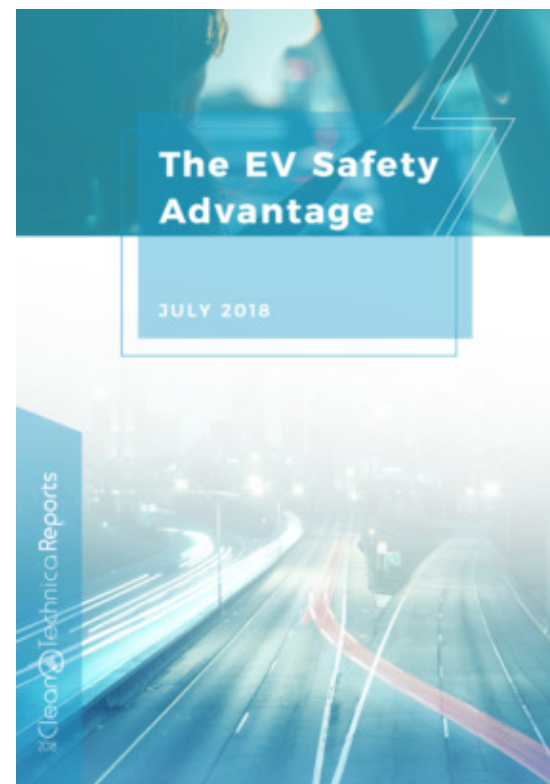
- Oil companies have, and will continue fight tooth and nail to protect their profits even after the research is clear — just like tobacco companies. Every day they delay EVs nets them nearly \$4 billion in gas sales, and every year earns them as much as \$26 billion in US taxpayer subsidies.
- Some companies are already being legislated into action, such as Volkswagen investing \$2 billion into EV chargers after selling 11 million cars that cheated on emissions tests. Given that oil companies knew about the harm they were causing as far back as the 80's and have a history of environmental disasters, they will likely receive more fines in the future.
- In the mean time, new companies like Chargepoint, EVBox, and EVGo are springing up to take down oil's monopoly on transportation power.

## Could they change?

- They're already following the money. Chevron is adding EV chargers to its gas stations, and several oil companies are investing in EV charging.
- The US currently has over 22,000 charging stations with 68,8000 outlets, vs 115,000 gas stations.
- EV chargers cost significantly less than gas pumps (as low as \$300 for a home charger or \$100k for 8 supercharging stalls vs \$500k for a gas station) and take up zero new space (they can be installed into an existing parking spot). This allows any business with a parking lot to generate revenue and attract customers.
- I'll be doing another post on the electric grid aspect of EVs, but the short answer is: yes, the grid can handle them. In fact, with new technologies like Vehicle-to-Grid, EVs could actually reduce the cost of electricity and make blackouts less common.
- Despite this, oil companies are increasing their investments in the exploration and exploitation of new oil sources.

## What would refueling look like in an EV future?

- Much smaller as an industry since most charging is done at home and much cheaper than gas.



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EV Charging Guidelines for Cities



- Logistically simpler (don't need chemical plants, networks of gas delivery trucks or explosion-proof stations) = lower barrier to entry, more competition, lower prices (aka a real free market, not oil oligopolies)
- Refueling stations will be safer, smaller and cheaper. Businesses are already investing in chargers to attract customers and employees. As the number of chargers continues to grow, it will be easier to recharge an EV than find a gas station.
- Electricity is decentralized, *giving you more freedom and choice*.

## 4. Consumer Demand

Even if we can make more EVs, do people want them? The answer, as you might suspect, is not as simple (or as negative) as headlines make it out to be.

For starters, there is actually a lot of interest: 63% of US buyers have at least some interest in EVs, with 29% of US buyers (and 65% of Chinese buyers) preferring to *not buy another gas car*.

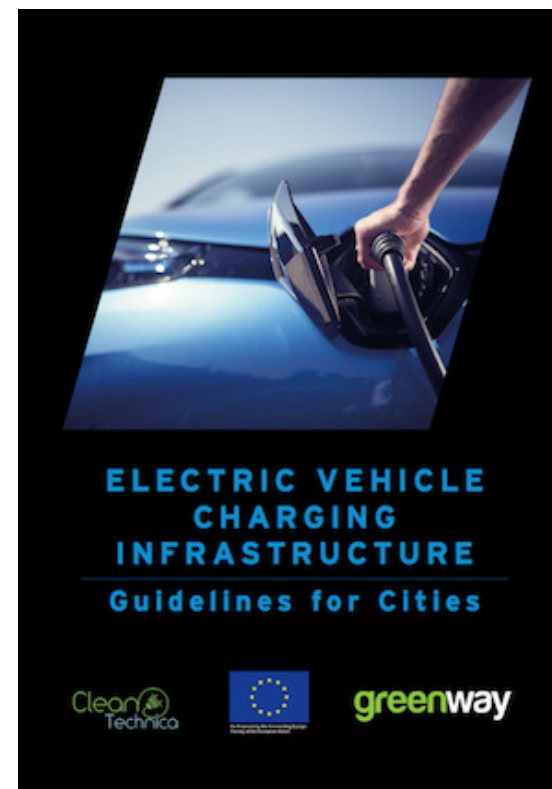
And that's with gas under \$3 gallon — imagine what'll happen if / when gas returns to over \$4 per gallon.

Here's what the Manager of Cars for Consumer Reports has to say:

*“Automakers and dealers have made little to no effort to market electric cars in the US, and yet this survey shows that Americans have widespread interest in them. Car buyers across the economic spectrum are interested in electric cars, but automakers and dealers are not providing consumers with enough information and selection to meet this demand.”*

## Demand Creation: Advertising & Product Placement

To truly understand demand, we must first understand how advertising and marketing influences consumers. After all, the automotive industry spends more on advertising than any other industry except retail.



*Share our free report on EV charging guidelines for cities, “**Electric Vehicle Charging Infrastructure: Guidelines For Cities.**”*

30 Electric Car Benefits

For starters, car companies spend over **\$40 billion** per year advertising their gas models, but **less than 1% of that** on their EV models.

Despite this, EV sales already represent more than **2%** of cars sold.

The effects of lack of advertising are easy to measure—most consumers have outdated ideas about EVs. A recent survey by Ford found that **65%** of Americans think EVs don't offer good all-wheel drive capabilities (false: EV traction control is more precise than gasoline's), and 67% think EVs have no towing capacity (false: see a Tesla **towing a jumbo jet**). Another survey found that non-EV owners are **20%** more likely to be worried about range than people who actually own EVs.

No wonder folks think an EV isn't right for them! Thankfully, companies are finally begin to invest in **consumer education**.

One final note about demand creation: Ever notice that cool people in movies, even in 2019, drive gas cars? That's because those companies spent **hundreds of thousands of dollars** to place those cars. Audi was the first company to place an EV in a major movie (**the E-Tron in Avengers: Endgame**). As we see more heroes and celebrities drive EVs, more people are going to start thinking they're cool.

## Cost Competitiveness

- The Tesla Model 3 is already **cheaper to own** than gas cars with comparable performance and features (such as the BMW 3-series).
- EVs will be upfront-cost-competitive with gas cars within 3 years (**2022**) due to increasing manufacturing scale and technology improvements.
- Once price parity is reached, we should expect the narrative to flip: it'll be gas cars that are seen as the toys for the rich.

## Range Anxiety & Charging

One of the most common excuses for not buying an EV is "range anxiety." This was definitely true with the first generation of EVs, but is it still relevant? While the 2011 Nissan Leaf only had **74** miles of range, the 2019 model can go 226 miles between charges (and the Model S long range can go **370** miles).



### Our Electric Vehicle Reviews



### 38 Anti-Cleantech Myths

(For some reason, nobody seems to talk about the gas car equivalent, which we've all experienced: "Oh shit, I'm late and forgot to fill my gas tank!")

## Daily driving

- AAA: The average motorist drives < 30 miles per day.
- DOT: Only 3% of trips are > 50 miles.
- McKinsey: a 160 miles range meets the daily driving needs of even intensive rural drivers.

The evidence is clear: EVs meet the vast majority of daily driving needs.

## Road trips

73% of Americans plan to take at least one road trip in 2019

The main concern with range anxiety is that you won't be able to reach the next fast charger. While that was true a few years ago, Superchargers will have 100% coverage of the continental US by the end of 2019:

1,604 Supercharger Stations with 14,081 Superchargers

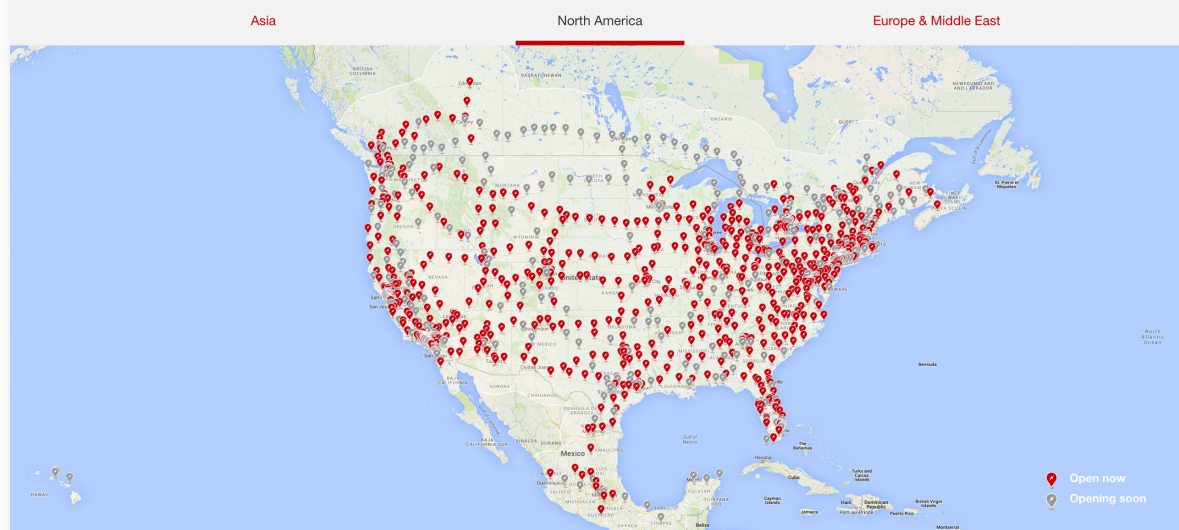
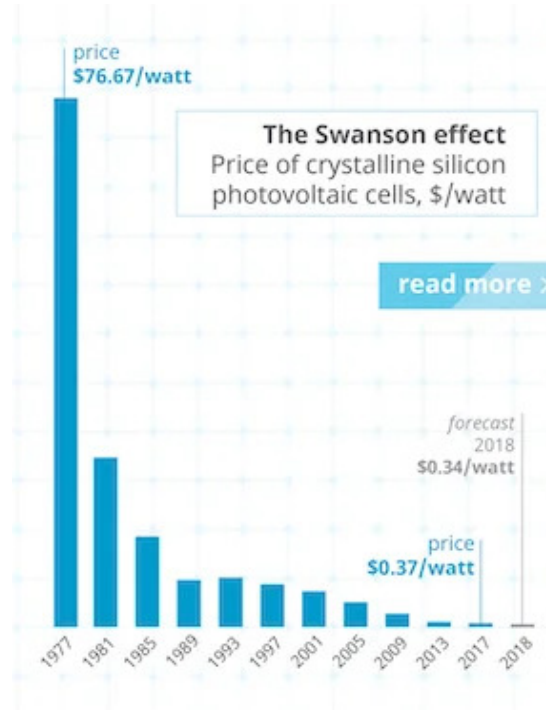
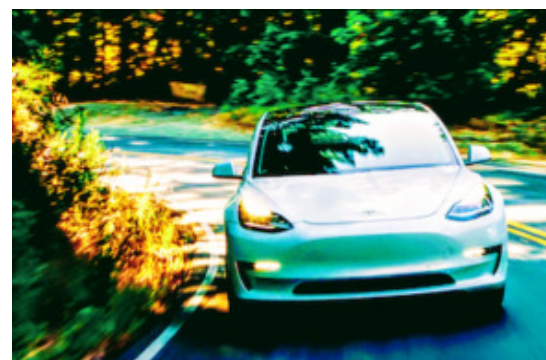


Image: Tesla



## Tesla News



On top of that, other charger networks have over 18,000 locations in the US.

Plus, anywhere you stay the night will have electricity — and many hotels and resorts now have high-speed destination chargers. “Ability to complete a road trip” is no longer a problem in 2019.

Once you know you can reach your destination, the next concern is speed.

It's true, EVs take longer to refuel than a gas car — for a sample trip driving from San Francisco to Los Angeles (380 miles), you'd spend 6 hours driving and 35 minutes charging, instead of 6 hours driving and 5 minutes at a gas pump, extending the trip 8%.

... unless you want to stop for food and the restroom on a 6 hour drive. That adds another 10–20 minutes for gas, resulting in a final trip difference of just 10 minutes, or less than 3%.

Of course, even if an EV takes a few minutes more to charge during a road trip, it net saves you time. By not having to stop at gas stations for daily driving, and requiring far less maintenance, an example Model 3 Long Range takes 50% less time per year to own than a comparable BMW i3.

### **The Extremes: Cold Weather**

It's true: EVs ranges decrease by 20% to 40% at 20°F .

Of course, gas cars are also around 20% less efficient at 20°F. Plus, they might not start.

It doesn't seem to stop Norwegians, where 58% of new cars are electric.

### **The Extremes: Holiday Traffic at Chargers**

Gas stations are already backed up during the holidays, and that's 5 minutes per car — could you have to wait for hours for a charger at the peak?

Today, traveling with an EV at peak times requires a bit of planning. Last Christmas saw Supercharger lines of 8 and 15 cars at some stations, with waits up to ~30 minutes.

However, this is being solved as we speak. As discussed in the refueling section, as gas stations continue to close and more EV chargers get built, highways will soon have *more*

chargers than gas stations. Plus, you'll never have to abandon your car because they ran out of gas.

## Are there enough options?

If consumers *aren't* interested, yet there *are* options that meet their needs, we're most likely looking at an advertising problem.

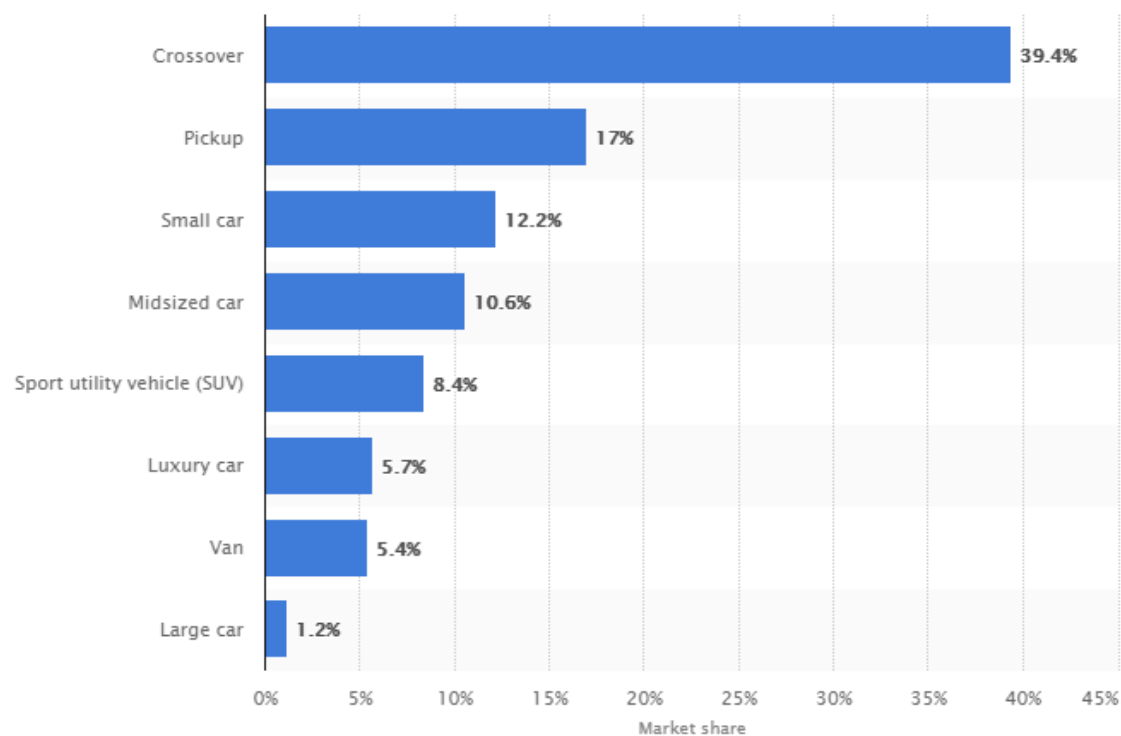
On the other hand, if consumers *are* interested, but there *aren't* good options available, that speaks to a lack of innovation by auto manufacturers.

Recalling that 63% of consumers are interested in EVs, it sounds like we might have a lack of options.

### Comparing sales: Gas models vs EVs



## U.S. light vehicle market in June 2019, by segment



Source: Statista

While these numbers vary depending on how you classify cars (another analysis classified 36% of global sales as SUVs), we can use this as a starting point for our analysis.

Comparing the above sales to the EVs available in 2019... there's not many:

- Crossover: Hyundai Kona, Jaguar I-Pace (Model Y expected in 2020)
- Pickup: None (Several expected in 2020)
- Small/medium car: Nissan Leaf, Chevy Bolt, Model 3
- SUV: Model X, Audi e-tron

- Luxury car: Model S
- Van: None

Right now, over 20% of gas models sold don't (yet) have a direct electric comparable. This will be solved in 2020, and should increase demand.

Also, many of the models that *are* available launched in the past year, and many consumers want to wait a few years for the technology to prove itself. As these models build reliability records and work out their kinks over the next few years, demand should increase further.

Finally: Considering how few options are available, they've won a jaw-dropping number of awards. The Hyundai Kona received Best Utility Vehicle. The Model 3 is the safest car available. The Jaguar I-Pace is the 2019 World Car of the Year. The Model S is Motor Trend's best car ever created.

(At this rate, you have to wonder if they'll make a special awards category just for gas cars so they can still win something)

### Comparing preferences: Consumer preferences vs EV values

Consumer Reports found that consumers want reliability, fuel economy and safety, all of which EVs are superior at.

In summary: There is a tremendous amount of interest in EVs, and EVs align with what consumers want in cars. The main obstacles to demand today appear to be consumer education, insufficient models / options available, and a few more years for the technology to move from "bleeding edge" to "proven" in the mind of the public.

## 5. Executive Compensation & Incentives to Innovate

This is perhaps the biggest threat to EVs (and the US economy) today. Companies and leaders are incentivized to fight change rather than innovate (see: Kodak bankruptcy):

- Publicly traded CEOs are rewarded for quarterly sales and stock growth, but switching to EV manufacturing is initially expensive and hurts their bonus, regardless of it's a good move in the long term.

- You have to dig into [page 35](#) of obscure SEC filings to see that even though 72% of GM's C-suite compensation is "performance based," their definition of performance is only over 3 years — barely enough time to build a factory, much less design & launch a product line based on new technology. Conversely, Elon Musk's [compensation at Tesla](#) is 100% at risk, and over a 10 year window. Now *that's* how to incentivize real innovation.
- Right now, most US consumers choose to purchase gas SUVs and trucks because gas is cheap. With the current political administration being run by [fossil fuel lobbyists](#) that are willing to [lower emissions standards](#) in exchange for ~~bribes~~ lobbyist dollars, companies correctly have no expectation that gas prices will change in the next few years (barring further conflict in the Middle East, which is [nearly guaranteed](#)), making it "the next CEO's problem".
- Auto + gas industries currently spend [\\$35 billion](#) per year on persuasive marketing and \$195 million per year on lobbyists ([\\$125M oil](#), [\\$70M auto](#)). There is significant precedent of companies manipulating politics and public discourse to overstay their welcome and keep extracting profits long after it's clear they're harmful to society (see: [tobacco](#), [guns](#))

## In Summary

EVs are expected to be the best choice for nearly all consumer automotive use cases by 2023. They will cost less than gas upfront and per mile, have plenty of range and have more refueling options than gas.

Their only downside is increasing the length of road trips by about 3%.

Despite only 1% of advertising budgets being spent on EVs, 63% of US buyers are interested in them. As advertising increases (and SUVs and trucks become available in [2019](#) and [2020](#)), we can expect demand to grow even faster.

Yet, companies today have little incentive to innovate and most are not prepared for this shift. Any company not already selling EVs will be [playing catch-up](#) in the 2020s, and may not survive as auto sales [continue to decline](#).

Companies that got ahead of the technology curve ([Nissan](#), [Hyundai](#), [Chevy](#) and [Tesla](#)) have a tremendous advantage. Even so, any company selling EVs will need to overcome several challenges, including:

- Educating consumers to understand their benefits vs gas, including fighting oil company misinformation and lobbyists

- Securing raw materials as mines rush to keep up with demand
- Re-purposing manufacturing and repair robots and labor
- Developing new profit models in a world with more reliable cars that don't depend on gas stations

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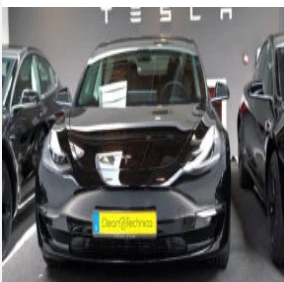


## About the Author

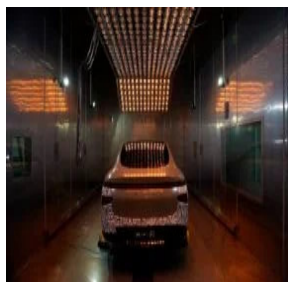
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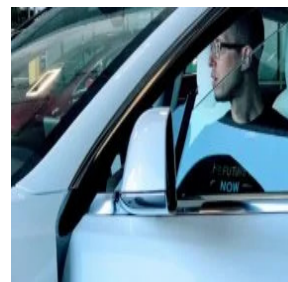
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